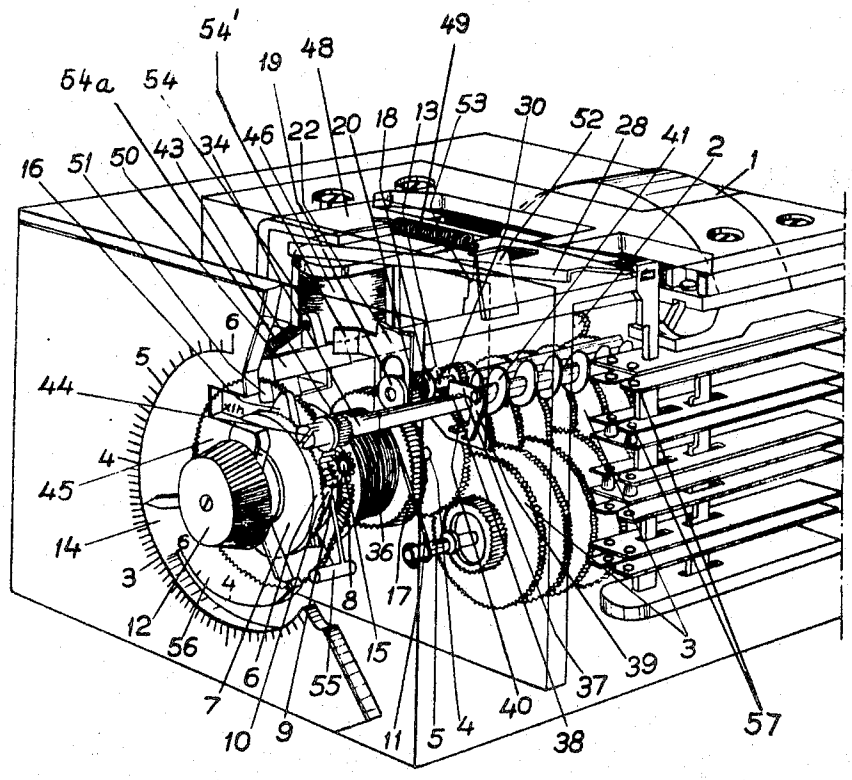
Jan. 6, 1970 LARS-OLAV PETTERSSON ET AL 3,487,699

TIME RELAY

Filed Jan. 25, 1968 2 Sheets-Sheet 1

Fig. 1.



INVENTOR.
LARS-OLAV PETTERSSON
RUNE SPANNBERG
BY
Jennings Bailey, Jr

Jan. 6, 1970 LARS-OLAV PETTERSSON ET AL 3,487,699

TIME RELAY

Filed Jan. 25, 1968 2 Sheets-Sheet 2

Fig. 1a

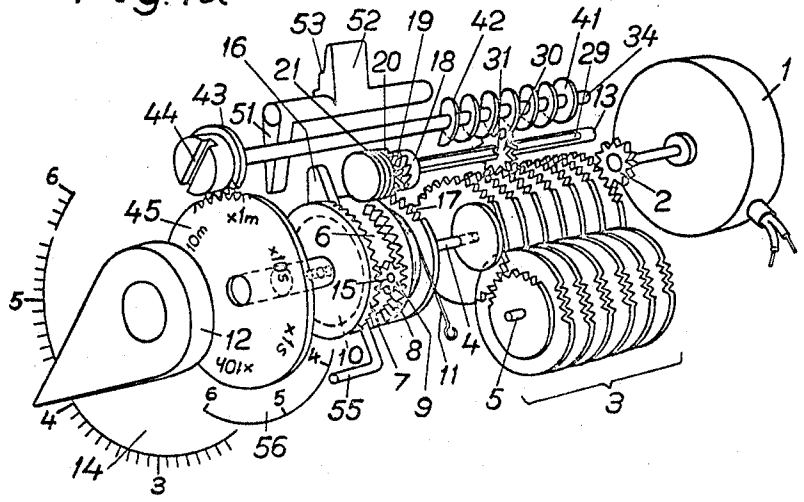


Fig. 2

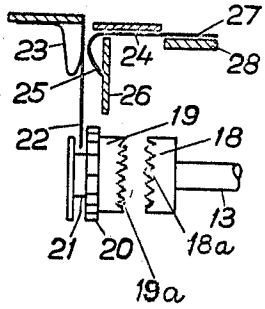


Fig. 3

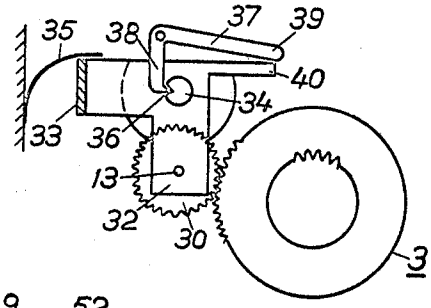
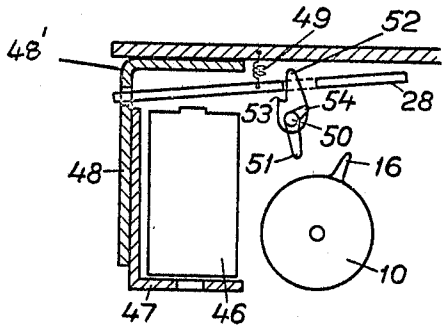


Fig. 4



INVENTOR

LARS-OLAV PETTERSSON

RUNE SPANGBERG

BY Jennings Bailey, Jr.

ATTORNEY

United States Patent Office

3,487,699
Patented Jan. 6, 1970

3,487,699

TIME RELAY

Lars-Olav Pettersson and Rune Spangberg, Vasteras, Sweden, assignors to Allmänna Svenska Elektriska Aktiebolaget, Vasteras, Sweden

Continuation-in-part of application Ser. No. 641,256, May 27, 1967. This application Jan. 25, 1968, Ser. No. 700,467

Int. Cl. F16h 5/74; H01h 7/12

U.S. Cl. 74—3.5

10 Claims

ABSTRACT OF THE DISCLOSURE

A synchronous motor drives a set of gears which intermesh so as to turn at different speeds. A gear is non-rotatably mounted on a shaft and displaceable therealong by a conveyer screw to mesh with one or another of such set of gears. A clutch is provided to connect or disconnect the shaft to a second gear which meshes with a third gear connected to a crown wheel of a planetary transmission, the other crown wheel of which is settable by hand. The planet wheel carrier at the end of its travel operates a device which allows the armature of a relay to drop, whereupon the motor is disconnected. At the same time, the clutch is opened and the parts returned to their initial position.

This application is a continuation-in-part of application Ser. No. 641,256 filed May 27, 1967, now abandoned.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to a time-lag relay driven by a synchronous motor.

SUMMARY OF THE INVENTION

According to the invention, the relay comprises a gear transmission coupled to the synchronous motor, a planetary gearing cooperating with a time setter and, between the two gear transmissions, a clutch operated by the relay armature for coupling the gear transmission, and a means for changing the prevailing scale range. An essentially distinctive feature of the time relay according to the invention is that the change-over means for the scale range comprises a toothed wheel which is non-rotatably mounted on a shaft and is displaced along said shaft, said toothed wheel being arranged to be displaced along the shaft to engage with a gear wheel in the gear transmission with the help of a conveyor screw arranged on a change-over shaft provided with a change-over device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 of the drawings shows the relay in perspective, with parts broken away; FIGURE 1*a* also shows a perspective view of the relay with certain parts removed. FIGURE 2 shows the means for operating the connection. FIGURE 3 shows the means for changing over different scale ranges and FIGURE 4 shows the release means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description, the time-lag relay according to the invention will be described with reference to the drawings.

On the shaft of a synchronous motor **1** is attached a toothed wheel **2** which drives a first gear of a gear transmission **3** having a suitable number of gear wheels arranged to run freely on two parallel shafts **4** and **5**. Each gear wheel consists of one small and one large

toothed wheel and a large toothed wheel on one of the shafts cooperates with a small toothed wheel on the other shaft.

The timing setting and release of the relay takes place with the help of a planetary gear transmission **6**. The planetary gear transmission comprises a first crown wheel **7**, a second crown wheel **8** and a planet wheel **9**. The crown wheel **7** is connected by means of a shaft to a setting dial **12** having a pointer cooperating with a scale **14** marked from 0.2–6. The planet wheel **9** is arranged on a free-running disc **10** which supports a radial shaft **15** on which planet wheel **9** is mounted and a release lever **16**, the function of which will be decribed later. The second crown wheel **8** is arranged to run freely on a shaft, suitably the shaft **4** in the gear transmission **3**. The crown wheel **8** is rigidly connected to a toothed wheel **17**. The crown wheel **8** and the toothed wheel **17** are arranged at a distance from each other and in the space between them is located a return spring **11**. One end of the spring is attached to the crown wheel and the other end is attached to a support in the relay, for example around the shaft **5** in the gear transmission. The spring tends to turn the crown wheel **8** and the toothed wheel **17** clockwise until a stop pin on the crown wheel hits a stationary stop in the relay.

To join together the gear transmission **3** and the planetary gear transmission a clutch is used consisting of two clutch halves **18** and **19** and a toothed wheel **20**, as shown in FIGURE 2. The clutch half **19** and the toothed wheel **20** are rigidly connected to each other and arranged to run freely on the shaft **21**. The toothed wheel **20** is in permanent engagement with the toothed wheel **17** in the planetary gear transmission. The clutch half **19** has a circular groove **21** outside the toothed wheel **20** in which a resilient tongue **22** engages. The tongue is attached at its upper end to the relay frame and pressed by a spring **23** against a yoke **24** which is fulcrumed at **25** on a stationary part **26** of the relay frame. Spring **23** has its left-hand part (FIG. 2) secured to a part of the frame while its right-hand part is free to press against member **22**. The other end **27** of the yoke is kept pressed against the upper side of the relay armature **28** by the spring **23**. In FIGURE 2 the relay armature is shown in the off-position of the relay. Parts **23**, **24** and **27** are broken away in FIGURE 1.

The shaft **13** is provided with a longitudinal groove **29** and a toothed wheel **30** having a projection **31** fitting into the groove is mounted for displacement along the shaft. As shown in FIGURE 3, the shaft is also journalled in two arms **32** on a clamp **33** which is in turn pivotably journalled on a change-over shaft **34** journalled in the relay framework.

By means of a spring **35** mounted on the relay frame, the clamp **33** is pressed counter-clockwise so that the toothed wheel **30** is kept in engagement with one of the gear wheels in the gear transmission **3**. Near the journalling point of the change-over shaft **34**, the shaft is provided with a groove **36** which is intended to be in engagement with one end **38** of an angled hook **37**, which is journalled in the frame. The other end **39** of the hook abuts a flap **40** of the clamp **33**.

As is best seen in FIGURE 1, a conveyor screw **41** is arranged on that part of the change-over shaft **34** lying opposite the gear transmission **3**. The conveyor screw is arranged so that the toothed wheel **30** of the shaft **13** projects into the screw thread **42** and is carried along by this thread when the shaft **34** rotates. The thread pitch is so chosen that the toothed wheel **30** is moved from one gear wheel in the gear transmission to an adjacent gear wheel when the change-over shaft **34** is turned one revolution. The change-over shaft operated from the front of the relay with the aid of a change-over device **43** con-

sisting of a head with a notch **44** so that the change-over can be performed by using a screw-driver. The change-over device cooperates with an index-disc **45** with indexes *x*1 s., *x*10 s., *x*1 min., *x*10 min., *x*1 h., *x*10 h. The index disc has the same number of indexes as the number of gear wheels on the shaft **5** in the gear transmission **3**. The index corresponding to the time limit set is visible through a window in the front plate of the relay.

In FIGURE 4 the relay coil is designed **46**. In a manner known per se, for example by means of angled plates **47** and **48**, it is attached to the relay frame. The armature **28** is journalled in an opening **48'** in the plate **48** and urged away from the coil by a spring **49** attached to it and to the relay frame. A release shaft **50**, also visible in FIGURE 1, supports a release lever **51** intended to cooperate with the release terminal **16** on the intermediate disc **10** and a blocking lever **52** is also provided with a step **53** thereon. Another lever **54** is arranged to co-operate with a sloping surface **54'** of the resilient tongue **22** if the motor **1** continues to rotate after the relay is released, so that the disc continues to rotate counter-clockwise and influence the release shaft **50**. The lever **54** and the resilient tongue **22** cause the connection **18**, **19** to open. Lever **54** has connected to it a spring **54***a* which tends to turn shaft **50** counter-clockwise.

In order to indicate how much time remains of a release period, the disc **10** is provided with an indicator **55** cooperating with a scale **56**. This scale is marked in the same way as the scale **14**, but has only half as great an angle range since the indicator **55** moves at half the speed at which the wheel **12** is turned when the time is set. At the same time that the synchronous motor starts to drive the planetary gear transmission, the indicator **55** moves from the value set towards zero and thus indicates continuously the time remaining until the relay picks up.

The movement of the armature **28** takes place in two steps as will be explained below, and in its movement operates to open and close various ones of the switches **57**.

The relay operates in the following way:

The desired release time is set by means of the dial **12** and the change-over device **43**. If the desired time is 30 minutes, the dial **12** is turned so that its indicator points to the numeral **3** and the change-over device **43** is turned until the window at the front of the relay shows *x*10 min.

The toothed wheel **30** has then been moved so that it engages with the third gear wheel counted from the front of the gear wheels on the shaft **4** in the gear transmission **3** as seen in FIGURE 1. When the dial **12** is turned the disc **10** with the planet wheel **9** is moved in the same direction but at half the speed at which the crown wheel **7** is turned.

Both the relay coil and the synchronous motor are so connected to the circuit through switches **57** that both are fed with current when the relay is connected, as by closing a switch connecting it to a current source. When the armature moves against the blocking surface **53** (downward in FIGS. 2 and 4), the member **24** is free to swing clockwise around the end **25** and the tongue **22** swings to the numeral **3** and the change-over device **43** is turned clutch halves **18** and **19** engage with each other.

The synchronous motor is thus connected and drives the planetary gear transmission so that the disc **10** with the release terminal moves counterclockwise in FIGURE 1. When the time set is almost up, the release terminal **16** is in contact with the release hook **51** on the release shaft and this starts to turn clockwise in FIGURE 1. When the release shaft has turned a little, the armature slides off the blocking surface **53** and falls into its final position. The circuit is then influenced by further switches **57** again so that the current to the synchronous motor is broken and other contact is made as required by the use to which the device is put. Since the armature is still in lowered position, the coupling between the gear transmission and the planetary gear transmission is closed. In order to prevent the disc in the planetary gear transmission from being driven too far if the current to the synchronous motor should not for some reason be broken when the relay armature reaches its final position, the extra lever **54** on the release arm by engagement with sloping surface **54'** acts on the resilient tongue **22** in FIGURE 2 so that the clutch is opened. As soon as the clutch has been opened, the armature returns because the current to the coil is broken by opening of the supply switch, the planetary gear transmission rapidly returns to its initial position and the relay is ready for a new operation. The shifting of the wheel **30** from one to another of the wheels **3**, produced by the turning of the threaded member **41**, takes place as follows: When shaft **34** is turned, the first moment of the turning causes the end **38** of the angled hook **37** to be pressed out of the groove **36**. During this moment the hook **37** is turned clockwise and the end **39** of hook **37** turns the flap **40** downwards and clamp **33** is turned clockwise. By this, the wheel **30** is brought out of engagement with any wheel of the gear transmission **3**. During almost the entire turning movement of shaft **34**, wheel **30** is completely free from and situated outside of the transmission **3**. When shaft **34** has been turned almost one turn, the end **38** of hook **37** will enter groove **36** due to the turning movement of spring **35**. At this time, wheel **30** on shaft **13** has been moved along axis **13** and is now opposite an adjacent gear of transmission **3**. When the end **38** enters groove **36**, wheel **30** is in engagement with a wheel in the transmission **3**.

The long time, up to 60 hours, which the relay may be connected before an operation takes place, makes it necessary to insert a clutch between the gear transmission and the planetary gear transmission and arrange for this clutch to be opened when the relay has operated. Otherwise the re-setting time would be impermissibly long. By dividing the closing movement of the armature into two parts an excellent opportunity is available to influence the clutch in a simple manner at the same time as they relay starts.

The extra hook on the release shaft also provides a safe emergency release for the clutch, which would not be obtained if the clutch were influenced electrically.

Since the time setting of the planetary gear transmission takes place by turning one of the crown wheels, the great advantage is obtained that an alteration of the time set may be accomplished even if the relay has started and the synchronous motor drives the other crown wheel in the planetary gear transmission. Change-over of the first crown wheel causes only the planet wheel to accompany it, regardless of whether the other crown wheel is stationary or in operation.

Such an alteration of the time set to another well-defined release time is possible only because of the indicator **55** arranged on the disc **10**, which always shows how much of the release time remains. Thus, if a different time is required, longer or shorter, the dial **12** is turned until the indicator **55** shows on its scale **56** the newly set time for the release.

What is claimed is:

1. Timing device comprising a synchronous motor, a relay having an armature, said device comprising a gear transmission connected to the synchronous motor, a time setter, a planetary gear transmission cooperating with the time setter, a clutch operatively connecting said two gear transmissions, means operatively connecting said clutch to the relay armature to close the clutch when the relay is energized for joining said gear transmissions, means for changing the prevailing scale range of said gear transmission, and means responsive to movement of the planetary gear transmission by an amount set on said time setter to de-energize said synchronous motor.

2. Timing device as claimed in claim **1**, in which said planetary gear transmission includes first, second and third gears, the first of said gears being connected to said time setter, the second of said gears being operatively connected to one of the parts of the clutch, and the third gear meshing with the first and second gears, the third gear having

said responsive means operatively connected therewith to produce said deenergization of the synchronous motor.

3. Timing device as claimed in claim 2, in which means are provided for normally limiting movement of said armature when said relay is energized to a part only of its range of movement, said armature at the end of such part of its range operating to close the clutch, and said means connected with said third gear including means operatively connected with said movement limiting means to render them inoperative so as to permit movement of said armature to its full range of movement.

4. Timing device as claimed in claim 3, means operatively connected with said movement limiting means and responsive to the movement thereof to inoperative position to disengage said clutch.

5. Timing device as claimed in claim 1, in which means are provided for normally limiting movement of said armature when said relay is energized to a part only of its range of movement, said armature at the end of such part of its range operating to close the clutch, and said means responsive to movement of the planetary gear transmission including means operatively connected with said movement limiting means to render them inoperative so as to permit movement of said armature to its full range of movement.

6. Timing device as claimed in claim 5, means operatively connected with said movement limiting means and responsive to the movement thereof to inoperative position to disengage said clutch.

7. Timing device comprising a synchronous motor, a relay having an armature, a first gear transmission connected to the synchronous motor, a time setter, a planetary gear transmission cooperating with the time setter, a clutch arranged between said two gear transmissions, means operatively connecting said clutch to the relay armature to close the clutch when the relay is energized for joining said gear transmissions, means for changing the prevailing scale range of said first gear transmission comprising a first shaft, a toothed wheel nonrotatably mounted on but displaceable along said shaft, a change-over shaft provided with a change-over device, a conveyer screw mounted on said change-over shaft, said toothed wheel being engaged by said conveyer screw for displacing said toothed wheel along said first shaft.

8. Timing device according to claim 7, a clamp, said first shaft being journalled in said clamp, said clamp being pivotably journalled around said change-over shaft, said change-over shaft having a groove, a knee lever journalled in the relay frame, one arm of said knee lever engaging said clamp, the second arm of said knee lever engaging said groove when a scale range is exactly set.

9. Timing device according to claim 7, a release shaft journalled in the relay frame, said release shaft being provided with a releasing lever arranged to cooperate with the planetary gear transmission, said release shaft being provided with a blocking lever arranged to cooperate with the relay armature, said blocking lever being provided with a blocking surface, the relay armature abutting said blocking surface when the armature has completed approximately half its movement under the action of said relay.

10. Timing device according to claim 7, a resilient tongue attached to the relay frame, said clutch comprising two parts, one of said parts having a circular groove, the free end of said resilient tongue being in operable contact with said groove, a curved yoke having one of its ends pressed against a rigid part of the relay frame, a spring pressing the other end against the relay armature, said resilient tongue being pressed against said yoke by said spring, said yoke and resilient tongue keeping said clutch closed as long as the relay armature is acted on by the relay coil.

References Cited

UNITED STATES PATENTS

2,979,969 4/1961 Fichter ---------- 74—3.52 X

MILTON KAUFMAN, Primary Examiner

U.S. Cl. X.R.

200—38